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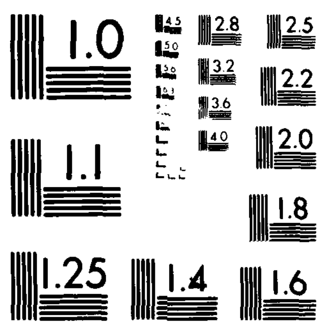

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Conservation tillage practices have been suggested as primary means of reducing non-point source phosphorus loadings to Lake Erie. Though research has shown that conservation tillage practices are feasible on many Lake Erie basin soils, adoption by farmers has been slow. Consequently, demonstration projects have been established in an attempt to speed adoption. Three large scale projects, the Honey Creek Watershed Project, the Allen SWCD Demonstration Project, and the Maumee Valley Demonstration Project are reviewed.

EFFECTS OF CONSERVATION TILLAGE PRACTICES ON CROP YIELDS IN THE LAKE ERIE BASIN

by

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Lake Erie Wastewater Management Study
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Donald J. Eckert[2]

ABSTRACT

Conservation tillage practices have been suggested as primary means of reducing non-point source phosphorus loadings to Lake Erie. Though research has shown that conservation tillage practices are feasible on many Lake Erie basin soils, adoption by farmers has been slow. Consequently, demonstration projects have been established in an attempt to speed adoption. Three large scale projects, the Honey Creek Watershed Project, the Allen SWCD Demonstration Project, and the Maumee Valley Demonstration Project are reviewed.

Project success with corn was quite variable. On some sites, yields of reduced tillage and no-tillage corn were lower than those of corn planted on plowed plots, while on others they were equal to or greater. In general, projects were more successful with reduced than no-tillage corn production. Projects were not equally successful producing no-tillage corn as compared to conventionally tilled corn on similar soil types. Yields were generally not as high as one might expect, given the levels of inputs and management utilized in the projects. Placing many demonstration plots on marginal sites seems to be the main reason for these effects.

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Projects were much more successful using conservation tillage to produce soybeans. This is most likely due to good weed control obtained on most sites, and lack of certain problems inherent in conservation tillage corn but not soybean production.

More careful site selection and an increased emphasis on conservation tillage soybean production are suggested for future demonstration projects.

INTRODUCTION

High phosphorus loadings have been identified as major contributors to the degradation of water quality in Lake Erie. The U.S. Army Corps of Engineers has studied this problem intensively, and reports several important conclusions in the "Lake Erie Wastewater Management Study Methodology Report" (U.S. Army Corps of Engineers, 1979):

1) "Non-point source phosphorus is derived principally from agricultural land use, particularly crop production."
2) "The bulk of the phosphorus from diffuse sources and inland point sources reaches Lake Erie in association with suspended sediment transported during storm events."
3) "Reducing gross erosion will reduce phosphorus loads to Lake Erie."
4) "Adoption of conservation tillage and no-till practices appears to be an economically feasible method of reducing potential erosion in the Lake Erie basin."

This philosophy has been adopted by other agencies and individuals, resulting in a proliferation of implementation/demonstration projects involving conservation tillage throughout the basin.

Conservation tillage simply describes a set of tillage systems which protect the soil from erosion by water and/or wind. Though increasing surface roughness by moldboard plowing is effective in some cases, the populist view holds that conservation tillage excludes the plow and involves systems which leave crop residues on the soil surface for erosion control. This can be accomplished through the judicious use of tillage tools such as chisel plows, disks, and field cultivators, or by slot planting into undisturbed soil (no-till). The erosion control benefits of these practices have been well documented.

A farmer's decision to adopt a conservation tillage system, however, may not be based entirely on erosion control. He is also interested in running a profitable operation and one factor which often enters into profit decisions is crop yield. Farmers will generally adopt a practice more quickly if that practice clearly enables him to maintain or increase yields. A great deal of research has shown that, with proper management, it is possible to produce yields using conservation tillage on many basin soils which equal or exceed those produced using conventional, plow-based tillage.

The ultimate success of any demonstration/implementation project may rest on the ability of farmers and technicians to duplicate these research results on a field scale. Several projects have been in operation long enough to accumulate information on crop responses over several years. The remainder of this report will focus on crop yields obtained in these projects, as they relate to anticipated results based on research data.

RESEARCH FINDINGS

Conservation tillage has been under investigation for over twenty years. Most of the work relevant to the Lake Erie basin has been conducted by scientists at the Ohio Agricultural Research and Development Center (OARDC) in Ohio, and at the Purdue Agricultural Experiment Station in Indiana. Three recurrent themes run through research at both institutions regarding successful conservation tillage: 1) getting a satisfactory initial plant stand; 2) controlling weeds; and 3) matching tillage system to soil type. Failure to accomplish any of the three can result in decreased yields. The first two are self-explanatory. The third has been subject to much debate and deserves more discussion.

Both Ohio and Indiana recognize that soil properties, particularly prevailing wetness, can greatly influence crop yields under various tillage systems. Both states have issued guidelines for matching soils and tillage. The Indiana system (Galloway _et al._, 1977) is quite detailed and includes recommendations for using several reduced tillage systems. The Ohio system (Triplett _et al._, 1973) is simpler, because its recommendations are slanted mainly toward no-till systems. For the sake of brevity, this report is based on the Ohio system.

The Ohio system places soil series into five tillage groups. The classification is based mainly on soil drainage characteristics, because, in general, no-tillage crop production is most successful on better drained soils. On poorly drained soils, no-till crop production is often less than had soil been plowed.

Tillage Group 1 includes soils which are moderately well, well, or excessively well drained. Major soil series of the Lake Erie basin falling into this ca ry i .ude Cardington, Canfield, Glynwood, Morley, and

Wooster. Crops grown on these soils may undergo periodic moisture stress in summer. Leaving a mulch cover on these soils conserves some water which would often be lost through runoff or evaporation (Van Doren and Triplett, 1969). Because of the extra water available for crop use due to the presence of mulch, yields are often higher than if the soil were plowed (Bone et al., 1977) (see Table 1) and free of surface cover.

Tillage Group 2 includes certain somewhat poorly and poorly drained soils. These soils normally require drainage improvements for optimum production, regardless of tillage system. Important basin soil series include Blount, Bennington, and Crosby. Conservation tillage is possible on these soils. If they are drained, yields may equal those of plow based systems (Table 2). If adequate drainage improvements are not provided, yields from conservation tillage may be lower, depending on tillage system chosen. Research on Blount silt loam in Indiana has shown that four year average corn yields are similar when plots were plowed, chiseled, or field cultivated, but significantly lower when no-till was used (Griffith et al., 1973). This site was undrained and a "plow sole" (a compacted layer) had developed in the profile. The importance of improving the drainage of Group 2 soils cannot be overstressed.

Tillage Group 4 includes very poorly drained, fine-textured, relatively high organic matter soils. These soils also require drainage. These soils may yield less under no-tillage than conventional, particularly in no-till continuous corn or soybean systems. Rotating crops and/or tillage normally improves no-till yields (Table 3). Hoytville, Pewamo, Latty, and Toledo are important soil series in this group.

Table 1. Corn yields on Wooster silt loam as affected by tillage system (Bone et al., 1977).

Rotation	Year 2-6*		Year 7-11	
	No-till	Plow	No-till	Plow
	bu/A			
Cont Corn	112	102	150	134
Corn-Soybean	103	94	151	139
Corn-Soy-Hay	110	109	157	155

* Do not compare yields between years.

Table 2. Corn yields on tiled Crosby silt loam as affected by tillage system (Bone et al., 1977).

Initial Tillage	Corn Yields: No Additional Tillage	Corn Yields: +Spring Field Cultivate (4")
	bu/A	
Spring Plow	--	140
Fall Plow	--	138
Fall Chisel (16")	148	146
Fall Chisel (8")	145	142
Fall Field Cultivate (4")	143	146
Spring Field Cultivate (4")	141	--
No-till	143	--
LSD .05	7 bu/A	

Tillage Groups 3 and 5 include soils which are not normally recommended for conservation tillage. These groups include soils with very poor internal water movement and soils on which few data are available. Mahoning and Paulding soils fall into these groupings. The more common methods of conservation tillage have usually produced unsatisfactory yields on these soils. However, ridge systems may offer a way to perform conservation tillage while avoiding the problem of excess wetness. Some farmer experiences have been satisfactory (Eckert and Schmidt, 1981); however, little hard data exist on which to base recommendations.

Although many soil series are found in the Lake Erie basin, the major associations of the central and western basins are Morley-Glynwood-Blount-Pewamo, Cardington-Bennington-Marengo, and Hoytville (in several associations). While aggregated data indicate large acreages of Group 1 soils, detailed soil maps show that fields containing these soils usually also contain much soil falling into Groups 2 and 4. In addition, many of the Group 1 soil areas may be severly eroded. When such soil geography is considered, it is logical to expect that few farmers will realize significant yield increases by switching to reduced tillage. However, the sum of research data indicates that, with proper management (including improved drainage), reduced tillage should result in yields approaching those obtained using the moldboard plow.

Table 3. Corn and soybean yields as affected by tillage and cropping sequence on drained Hoytville clay (Bone *et al.*, 1977).

		Corn Yield			Soybean Yield
Time	Tillage	Cont. Corn	Corn-Soybean Rotation	Corn-Oat-Hay Rotation	Corn-Soybean Rotation
		bu/A			
First 8 Years	Plow-Disk-Plant	106	112	110	38
	Plow-Plant	107	112	110	37
	No-till	90	108	109	37
	LSD .05		6.1		5.0
Next 5 Years	Plow-Disk-Plant	135	136	143	39
	Plow-Plant	134	139	141	41
	No-till	114	131	137	34
	LSD .05		9.4		3.5

DEMONSTRATION RESULTS

For several years, there has been increasing interest in reduced tillage in the Lake Erie basin. Several demonstration efforts have begun, from large scale, multi-county projects to small, locally sponsored sites. Larger projects have employed staffs which help plant and harvest plots, maintain records, and conduct informational programs. Smaller ones have been staffed on a part-time, voluntary basis. Regardless, all projects have been concerned with growing corn and soybeans at acceptable yield levels. In the remainder of this report, several projects in the Ohio portion of the Lake Erie basin will be examined as to their performance in growing crops under reduced tillage practices. This will be strictly agronomic evaluation, and no judgement as to the success of an individual project in demonstrating or promoting reduced tillage is intended.

It must be remembered that such demonstrations generate non-statistical data. Plots have not normally been replicated at a given site, and management practices often vary from site to site. Standard biometric techniques, such as analysis of variance, are not applicable in these situations, and paired comparisons are probably not valid, either, because even at individual sites, conditions often vary between plots. Therefore, no statistical analyses have been attempted.

Descriptive "success rate" statistics have been calculated for the major projects, however, indicating the percentage of plot comparisons in which yields from a given tillage practice equaled or exceeded those of plow-based, conventional tillage. Two percentages will be given. The first represents absolute success, that is, cases where reduced or no-till yields were actually

equal to or greater than plow based yields. Since variation is inevitable in any plot work, a second percentage is given, also, which allows for some error of measurement. "Least significant differences" in replicated plot studies of tillage are often in the ranges of 5-10 bu/A for corn and 2-4 bu/A for soybeans. The upper limits of these ranges were used to determine a second success rate percentage. By incorporating such a criterion, reduced tillage corn yields which were less than plow yields by fewer than 10 bu/A were judged equal to those yields (similarly for soybeans at 4 bu/A less or fewer). Such success rates will obviously be higher than absolute rates, and the true success rate of a project probably lies somewhere between them.

Perfect success should not be expected from any project. As stated earlier, many sites in the basin could produce yields approaching or equal to plow based yields when reduced tillage is used. However, in such an "equal" situation, there is just as great a chance that reduced tillage yields will be slightly below plow based yields as slightly above. Therefore, success rates of approximately 50-60 percent should show adequate agronomic practice in a particular project.

The Honey Creek Watershed Project

The Honey Creek Watershed Project, operating in Crawford, Huron and Seneca Counties in Ohio, has been a three year project sponsored by the U.S. Army Corps of Engineers. A project staff, consisting of a manager and two technicians, has been employed to carry out the project. The staff has enlisted the aid of appropriate agricultural agency personnel (Cooperative Extension Service, Soil Conservation Service, Soil and Water Conservation Districts, Agricultural Stabilization and Conservation Service) when

necessary. Cooperators have been gathered on a voluntary basis. Results from 1979 and 1980 have been published in annual reports (Honey Creek Joint Board of Supervisors, 1980, 1981), and the information reported below has been drawn from these sources.

Table 4 shows the absolute yields of corn and soybeans grown using different tillage systems from 1979 to 1981. This table represents yields from all farms included in the study, and county averages, which are based on Ohio Crop Reporting service statistics (Carter et al., 1980, 1981). Yields indicate that, in general, the project staff was able to raise yields above those of the average farmer by using improved management techniques, such as earlier planting, good weed control, etc. The staff was more successful growing soybeans than corn using conservation tillage. This becomes more evident when one examines only those sites where tillage systems were compared side-by-side (1980 and 1981 only).

Table 5 shows results of comparison plots on individual farms. Since not all farmers planted comparison plots and comparisons differed between farms, numbers of plots differ from Table 4 and within Table 5. Chisel plowing, disking, and field cultivating are grouped as "reduced tillage" in this and all remaining comparison tables. This table shows that the project staff was quite successful raising no-till soybeans, somewhat successful at reduced tillage corn, but not consistently successful raising no-till corn. Both comparative yields and success rate percentages follow this trend.

Poor plant stands are often blamed for the lower yields of no-till systems. In this project, however, average plant stands were essentially identical (22,500 plants/A for plowed plots, 22,200 plants/A for no-till plots). On several sites poor stands did contribute to reduced yields, but at

Table 4. Performance of corn and soybeans under different tillage systems, Honey Creek Project, 1979-1981.

Tillage	Corn		Soybeans	
	No. Plots	Yield (bu/A)	No. Plots	Yield (bu/A)
Plow	28	123	15	45
No-till	67	116	18	46
Chisel	13	122	3	47
Disk	11	125	3	36
Field Cultivate*	4	137	--	--
3 County Av.†	--	116	--	36

* No 1981 tests.

† 1981 yields estimated by author.

Table 5. Results of comparison plots, Honey Creek Project, 1980-1981.

Comparison	No. Plots	Yields		Success	
		Plow	Comparative Tillage	SR_A*	SR_E
		-----bu/A-------		------%-----	
Corn-no-till	30	124	109	17	47
Corn-reduced tillage	11	111	119	64	82
Soybeans-no-till	11	45	47	45	91
Soybeans-reduced tillage	3	46	44	33	67

* SR_A = absolute success rate, SR_E = success rate with error.

six of the seventeen sites in 1980, no-till yields were lower despite better stands than plowed comparisons. Other factors must have also been involved in reducing no-till corn yields.

Observations that the project staff was quite capable of producing competitive yields of no-till soybeans while experiencing some difficulty with no-till corn are not necessarily surprising. There are basic differences in the management of these crops, which, in many cases, may make no-till soybean production a simpler system. These differences will be reviewed after the remaining demonstration efforts have been examined.

The Allen SWCD Demonstration Project

The Allen SWCD Demonstration Project has been operating in Allen County, Ohio. It is funded primarily by the U.S. Environmental Protection Agency. Unlike the Honey Creek Project, it is administered and staffed mainly by existing agency personnel. Comparative yields are available for three years for corn, but soybeans are a new crop for this project, and only 1980 yields are available (with only one comparison). Project results have been published (Allen Soil and Water Conservation District, 1981) and information presented herein is drawn from that source.

Table 6 shows the overall yields of all plots and tillage systems in 1978-80 for corn and 1980 for soybeans. Fall and spring operations involving the same tillage have been grouped together because few direct comparisons between operations were made. In general, timing of a particular tillage operation is not important on soils that predominate in Allen County, unless spring tillage delays planting or is done when soils are too wet. Yields have also been averaged across years, because few year to year comparisons are available.

When averaged over three years, corn production has kept pace with the county average. There seems to be no overall increase in corn management skills resulting from the project. However, it is also apparent from Table 6 that conservation tillage systems have performed as well as plow based ones when averaged over all sites.

Soybean production was well above the county average, as was the case in the Honey Creek Project. Again, conservation tillage compared favorably to plowing. The observation that soybean production in both projects has been well above the county averages is not altogether surprising, because methods of producing soybeans are rapidly changing. Earlier planting, planting in narrower rows than in the past, and using higher rates of potassium fertilizers are relatively new techniques for boosting production, which are slowly being adopted by farmers in general. However, project managers, concerned with doing a good job, have seized upon these methods and incorporated them on many sites. The results are obvious as one looks at yields of soybeans in Table 4 and 6.

Yields from comparison plots are shown in Table 7. Again it will be noted that (as with Honey Creek) the project staff was more successful producing reduced tillage corn than no-tillage corn, on a comparative basis. Yields are obviously lower for reduced tillage corn in these cases, but this was because the bulk of comparisons were made on lower producing farms (examine comparable plow yields). Success rates are particularly favorable for reduced tillage. These results are encouraging, considering the predominance of Group 2 soils in Allen County. Conservation tillage practices seemed to perform as expected in this project, when one considers research data.

Table 6. Corn and soybean yields as affected by tillage system, Allen SWCD Project, 1978-1980.

Tillage	Corn		Soybeans*	
	No. Plots	Yield (bu/A)	No. Plots	Yield (bu/A)
Plow	25	116	2	51
No-till	32	117	7	49
Chisel	5	120	-	-
Disk	9	116	3	48
Allen County Average (1978-80)	-	117	-	39

* 1980 only.

Table 7. Results from comparison plots for corn, Allen SWCD Project, 1978-80.

Comparison	No. Plots	Yield		Success	
		Plow	Comparative Tillage	SR_A	SR_E
		bu/A		%	
No-till	24	116	111	38	67
Reduced tillage	9	103	102	56	77

The Maumee Valley Project

The Maumee Valley Project operated for three years in Defiance, Fulton, Henry, Paulding, and Williams Counties in Northwest Ohio. It was a cooperative effort of the Maumee Valley Resource Conservation Development and Planning Organization, and various local agricultural agencies.
A technician was employed specifically to handle operation of the project. Results have been published (M.E. Kroetz, Conservation Tillage Trials: A Three Year Summary). An effort was made in this project to keep careful records on soil type, allowing information to be reported in this light.

Most tillage trials have been conducted on fields that were predominatly Blount with some Glynwood, indicating a Tillage Group 1-2 situation. Some have been conducted on Tillage Groups 3 and 4. Only one trial involving soybeans is reported on a Group 2 site. On it, disking compared favorably to plowing.

Corn yields on Group 1 and 2 soils as affected by tillage system are shown in Table 8. Again, the project staff has been able to produce acceptable corn yields with a variety of tillage systems. No-till and disking are the lowest yielding overall, but this appears due mainly to weed control failures and loss of nitrogen in a few no-till plots. However, chisel plowing compared favorably to moldboard plowing.

Corn yields in comparison plots are shown in Table 9. Though no-till yields were lower than plowed comparisons, success rates were acceptable, indicating that very bad yields in a few plots were responsible for bringing the average down. As noted in the other projects, reduced tillage corn was more successful than no-till corn.

Trials were also conducted on more poorly drained soils, Latty and Hoytville. Results are given in Table 10. Only comparative information is given, because differences in yields and practices between such few sites would give a distorted impression of overall tillage system performance. Success rates, again, were good, perhaps very good for no-till, because the practice is not particularly well suited to these soils without improved drainage and strict adherence to crop rotation.

A final feature of this project was the inclusion of several plots where corn or soybeans were planted on ridges. This system is currently under investigation as a means of allowing reduced tillage on very poorly drained soils such as Paulding. When ridge plantings were compared to plowing on Paulding and Latty soils the success rates for corn (8 cases) and soybean (2 cases) were 62 and 100 percent respectively. This system appears to hold promise, particularly for farmers with poorly drained fields who are unable to make drainage improvements.

Table 8. Overall corn yields as affected by tillage system. Group 1 and 2 soils, Maumee Valley Project, 1978-80.

Tillage	No. Plots	Yield (bu/A)
Plow	10	118
No-till	15	103
Chisel	10	118
Disk	5	105
5 County Average	-	112

Table 9. Corn yields on comparison plots, Group 1 and 2 soils, Maumee Valley Project, 1978-1980.

		Yield		Success	
Comparison	No. Plots	Plow	Comparative Tillage	SR_A	SR_R
		-------bu/A--------		-----%-----	
No-till	19	109	97	37	58
Reduced Tillage	17	105	101	53	76

Table 10. Corn yields on comparison plots, Hoytville and Latty soils, Maumee Valley Project, 1978-1980.

		Yield		Success	
Comparison	No. Plots	Plow	Comparative Tillage	SR_A	SR_R
		-----bu/A-------		------%-----	
No-till	6	106	104	50	66
Reduced Tillage	5	94	86	40	60

Discussion

Though quite a few observations are available from these projects, it is quite difficult to draw precise conclusions on specific comparisons. While it is possible to draw general conclusions on the overall performance of conservation tillage in northwestern Ohio (particularly on Group 2 soils), and even propose some general factors which may have influenced this performance, more detailed comparisons are probably not valid. There are simply too few observations available to make comparisons of factors such as variety selection, timing of operations, climatic effects, etc. Therefore, any discussion of these projects can only be of a general nature.

As one peruses the three projects reviewed here, several factors become apparent. With regard to corn production, overall yields at comparison sites were generally lower on no-till and reduced tillage plots than on plowed plots. Success rates were generally higher when some form of tillage was used, as opposed to no-till. However, on some sites, no-till and reduced tillage corn yields were equal to or higher than yields of corn planted in plowed soil. Physical conditions of the various sites may be responsible for much of the variation.

Lack of adequate drainage may be one key problem. The majority of comparison sites were on soils of Tillage Group 2, soils which require some form of drainage improvement for optimum production. Without improved drainage, these soils can be quite wet, particularly in the spring. Allowing mulch to cover undrained sites would only aggravate the moisture problem by reducing the potential for evaporation. Particularly in relatively wet years, this could result in an unfavorable response to reduced tillage systems.

Most of the drainage systems installed on Honey Creek Project sites were described as "random". In the Maumee Valley Project, drainage systems were described as being better on Group 4 sites than Group 2 sites, a result of farmers normally coping with a greater moisture problem on these soils (M.E. Kroetz, Personal Communication). Success rates for no-till were also higher for Group 4 sites, an outcome which might not be expected were this drainage variable not known. The importance of providing adequate improved drainage where needed is a point stressed by many extension specialists, and its importance seems to be confirmed by these demonstration projects.

The hypothesis that many of the sites used to demonstrate conservation tillage corn production were not in optimum physical condition (drainage problems, compaction, poor soil structure, etc.) tends to be confirmed by one other observation. The cultural practices used on plots were similar to those used in research studies. Weed control was very good. Seeding and fertilizer rates were quite high, and much planting was done during the optimum planting period. This is a much more rigorous production scheme than is used by many farmers, yet in years when research plots were producing 150 bu/A+ corn yields, projects were only producing yields near county averages of 110-125 bu/A. Given the high level of inputs and careful management, poor soil conditions are most likely responsible for the mediocre yields, since they were the factors over which the project managers had least control.

Use of urea-based nitrogen fertilizers can cause yield reductions in no-till corn when compared to other nitrogen sources (Bandel et al., 1980; Eckert, unpublished data). This information has only recently become available, and all project managers have reported that use of urea possibly caused problems in certain plots. Proper management of urea-based nitrogen sources should be practiced if success of reduced and no-tillage-practices is to be achieved on a consistent basis.

While no-till corn production has caused some problems, no-till soybean production has been quite successful. The Honey Creek Project was much more successful with no-till soybeans than corn, and the Allen SWCD Project, while short on comparison plots, also seems to be showing success. No-till soybean production may become more attractive in the future, if adequate weed control can be achieved.

The reasons are fairly simple. Soybeans are planted later in the season when soils are drier, possibly creating more favorable conditions for early growth. Soybeans are also planted at rates far in excess of desired final stand. This combination makes obtaining a stand of no-till soybeans a fairly simple matter. Since soybeans are leguminous, they require no nitrogen fertilizer, and urea problems are avoided. When these factors are considered, they should make no-till soybeans quite appealing to farmers.

Poor weed control has been the factor most limiting the growth of no-till soybean production. Weed control has been easier for no-till corn, explaining why it has become popular more quickly, even though it is a more complex system. However, several new herbicides have recently been, or soon will be, labeled which should make weed control in no-tillage soybeans a much simpler task. Particularly exciting are the newer post-emergent herbicides, which enable farmers to kill weeds after the crop has emerged. In the past cultivation has primarily been the only solution available for the problem of weed escapes.

The success of no-tillage soybean production in these projects is due in large part to good weed control. While it was also good for corn, achieving weed control probably gave soybeans an advantage over corn in conservation tillage trials because wet soil and nitrogen problems were less critical for the soybeans. Had weed control been a problem, the results may have been different.

The projects reviewed above lead to several conclusions and recommendations. Foremost is that the results of research efforts are applicable to the use of conservation tillage systems in production agriculture. Reduced tillage crop production is feasible on Group 1, 2 and 4 soils; however, success will be site specific (i.e. the better the site, the better the likelihood of success). Both no-till corn and soybean production systems are feasible, and if good production practices are followed, yields should not decline. Yields will be lowered, however, if mistakes are made.

Managers of future demonstration projects can learn several concepts from these efforts. Reduced tillage crop production requires more than just getting a stand and controlling weeds. Sites must be selected carefully. A small but successful project may be more beneficial than a large one with many poor comparisons. Inputs should be managed carefully, particularly nitrogen fertilizer sources. Finally, no-tillage soybeans should be a part of the project. Recent advances in weed control have made this a very attractive system.

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